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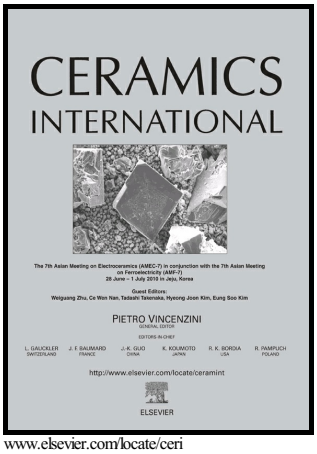

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Nb_2AlC-particle induced accelerated crack healing in ZrO_2–matrix composites

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Abstract

The oxidation induced crack healing behavior of pre-cracked Nb_2AlC particle loaded ZrO_2-matrix composites was explored by annealing in air at 1200 °C for short periods of 10 and 20 min. Composites loaded with 0, 6.5, 13, and 19.5 vol. % Nb_2AlC powder dispersed in 3Y-TZP matrix powder were manufactured by spark plasma sintering (SPS) at 1300 °C. Semi-elliptical artificial surface cracks with a length exceeding 220 µm were produced by Vickers indentation. The modulus of rupture of virgin, indented and annealed samples was measured in three-point bending mode. Compared to single phase 3Y-TZP strength recovery of the Nb_2AlC loaded composite upon annealing at 1200 °C in air is accelerated and reaches > 60 % of the initial strength after a short healing period of 10 min only. A semi-empirical oxidation cohesive zone healing model was derived which describes the crack microstructure evolution as a combined effect of 3Y-TZP-matrix healing superimposed by Nb_2AlC particle oxidation induced healing.

Key words

Crack healing; Nb_2AlC particle inclusion; ZrO_2-based composites

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